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PULP & PAPER

June 1987

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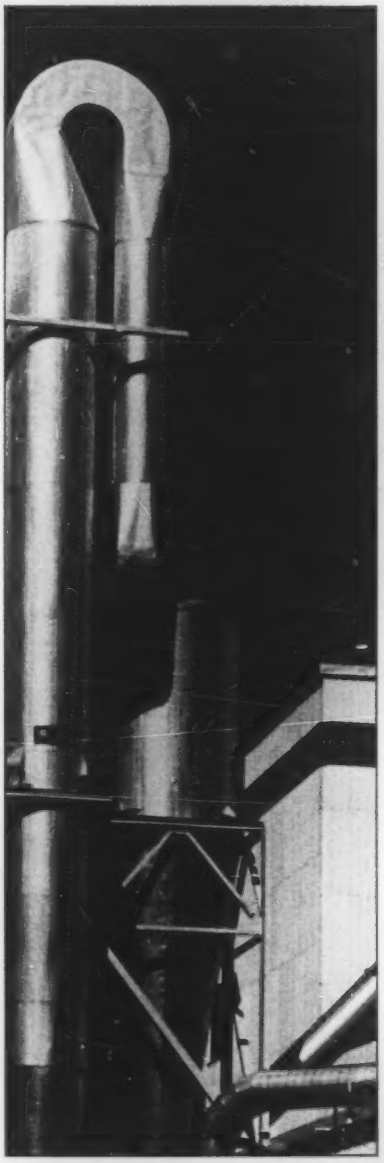

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Pulp from Temcell's new bleached CTMP mill at Temiscaming, Que., is marketed for use in a wide variety of tissue and paper grades. **(Photo courtesy of Communications DG4/G. Wells.)**

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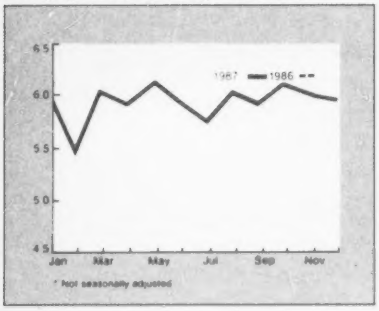
U.S. paper and board production



U.S. production of paper and paperboard totaled 6.3 million tons in March, up 4.7% from the comparable month last year, according to the American Paper Institute. On a seasonally adjusted basis, production during the first quarter reached an annualized pace of almost 72.5 million tpy. That performance is 4.5% better than the same period last year and represents capacity utilization of 95%, API reported. First-quarter paper output was a seasonally adjusted 35.8 million tpy, up 2.9% from last year, while paperboard averaged a 36.7-million-tpy rate for the period, for an operating rate of 97%.

Among major grades, coated paper continued to lead the way, with production up 8.9% compared with last year. Containerboard production for domestic use continued to benefit from record box shipments, rising 7.3% during the first quarter, API said. Unbleached kraft lineboard production for export was down 2.9% compared to last year, however, although actual exports of liner remain well above depressed year-earlier levels.

Canadian newsprint shipments climbed 12.2% in March compared with the previous year, as mills operated at 100% of capacity compared with only 89% in March 1986. Woodpulp exports fared well also, with shipments rising 5.9% and operating rates climbing to 97%, up from 87% last year. ■

	Latest month (000 short tons)		% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION[1]					
Newsprint	Mar.	475	−2.9	5,624	1.4
Uncoated groundwood (s)	Mar.	134	8.1	1,586	6.1
Coated paper (s)	Mar	553	9.7	6,586	8.9
Uncoated free sheet (s)	Mar.	923	1.0	10,638	2.0
Other printing/writing	Mar.	120	−5.5	1,393	4.0
Total packaging and other paper (s)	Mar.	444	−0.4	5,191	0.7
Tissue	Mar.	435	0.9	5,153	1.4
Total paper	**Mar.**	**3,083**	**1.6**	**36,170**	**2.9**
Unbleached kraft paperboard	Mar.	1,559	6.1	18,118	5.8
Semichemical medium	Mar.	491	12.1	5,645	8.8
Bleached paperboard	Mar.	390	3.2	4,458	4.2
Recycled paperboard	Mar.	754	11.7	8,710	6.6
Total paperboard	**Mar.**	**3,194**	**7.9**	**36,897**	**6.1**
Total U.S. paper and paperboard output	**Mar.**	**6,278**	**4.7**	**73,067**	**4.5**
PULP, WASTEPAPER & FIBER[2]					
Total U.S. woodpulp production	Feb.	4,622	4.9	58,224	5.0
Market pulp production	Feb.	595	1.0	7,574	4.1
Wastepaper consumption at paper/board mills	Feb.	1,380	7.2	16,869	2.7
Pulpwood consumption (cords)	Feb.	7,541	3.9	93,540	3.0
CONVERTED PRODUCTS STATISTICS[3]					
Corrugated box shipments (billion ft²)	Mar.	24,755	10.3	72,167[6]	5.0
Containerboard inventories at U.S. box plants and mills	Mar. 1	2,391	−3.9		
INTERNATIONAL TRADE[2]					
U.S. paper imports (including products)	Feb.	970	0.7	12,242	7.4
Imports of Canadian newsprint	Feb.	673	−4.7	8,694[6]	6.2
U.S. paper exports (including products)	Feb.	415	18.9	4,950	16.1
Exports of unbleached kraft linerboard	Feb.	205	55.3	2,264	31.0
Exports of woodpulp	Feb.	372	8.8	4,068	−4.4
Norscan pulp inventories[4]	Mar. 31	867	−23.5		
Norscan pulp operating rates[4]	Mar.	99%	100%	97%	98%
CANADIAN STATISTICS[5] *(reported in metric tons)*					
Total newsprint shipments	Mar.	846	12.2	2,352[6]	8.7
Operating rates	Mar.	100%	89%	99%	92%
Inventories held by U.S. consumers	Mar. 31	1,364	−2.9		
Other paper/board shipments	Mar.	549	11.1	1,579	8.7
Woodpulp shipments (export only)	Mar.	792	5.9	1,993	4.9
Operating rates	Mar.	97%	87%	98%	89%

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fibre Box Assn., Paperboard Packaging Council. 4. North American/Scandinavian paper-grade market pulp. 5. Canadian Pulp & Paper Assn. 6. Not annualized. (s) = Shipments.

CORRUGATING MEDIUM: High operating rates continue in 1987 with rising prices

Grade structure: Corrugating medium, the middle fluting material used in corrugated containers, is made from both semichemical pulp and recycled fiber. In 1986, 78% of corrugating medium was made from semichemical furnish (which normally contains at least 20% recycled fiber) and 22% was "bogus" medium made from wastepaper. Basis weights of corrugating medium are 22, 26, 33, 36, and 40 lb/1,000 ft².

Standard sheet weight is 26 lb, which accounts for more than 80% of production. Recycled medium for equivalent uses is normally produced in slightly higher weights.

Production/capacity: Production of corrugating medium rose 7.3% in 1986 to 6.9 million tons from the previous year. This reflected a 6.9% jump in U.S. corrugated box shipments.

Semichemical medium output rose 5.6% in 1986 to 5.37 million tons, while recycled medium production jumped 14.1% to 1.55 million tons.

This resulted in an extremely high 97.2% operating rate for semichemical medium and a 100.6% rate for recycled medium. (The high operating rate figures indicate that official industry capacity estimates may be understated.)

Outlook: The outlook for corrugating medium this year and beyond is fairly bright. For the first quarter of 1987, total corrugating medium production was running more than 8% above a year ago.

For all of 1987, however, medium output is expected to be up 3.7% to 7.2 million tons. This is based on 3% growth in U.S. corrugated box shipments and a slight rise in board inventories. Corrugated box shipments have been outpacing real GNP growth and industrial production, which are both expected to rise 2.5% in 1987, according to the consensus of economists surveyed by *Blue Chip Economic Indicators*.

No new semichemical medium machines have been announced in the U.S.; and capacity is only expected to rise 0.5% in 1987 and 0.7% in 1988. Part of the reason for this slow growth is Willamette Industries Inc.'s plan to convert a 260-tpd semichemical medium machine to linerboard production in mid-1987. Recycled medium capacity is expected to show somewhat faster growth, rising 7.5% in 1987 and 3.1% in 1988. Chesapeake Corp. converted a linerboard machine to produce 325 tpd of recycled medium at the end of 1986.

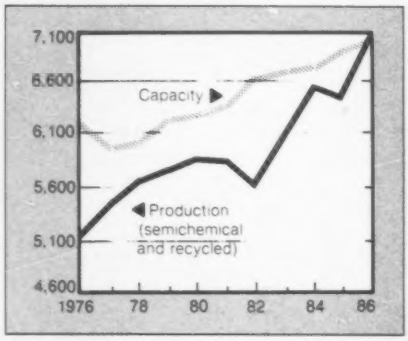
The U.S. containerboard industry has been undergoing a major period of consolidation. The expected sale of Owens-Illinois Inc.'s Forest Products Div. (No. 2 medium producer) could significantly change capacity rankings in this grade.

Prices: Corrugating medium prices have been rising along with linerboard, although the differential between the two grades has increased. Semichemical medium list prices rose to $340/short ton in the eastern U.S. in January, although transaction prices in some sections of the country range from $310 to $330. Linerboard has been firm at $350 (before zone discounts). In recent years, a $10/ton price differential has existed between the two grades.

Among the reasons for the larger than normal price gap are lower manufacturing costs for medium, shorter shipping distances from many northern mills, availability of wastepaper-based board of varying quality, and low-priced imports from Canada and Mexico. Although gaps with linerboard may persist, medium prices are expected to rise by about $30/ton in the fall of 1987.

Price history at year-end for 26-lb semichemical medium in the eastern U.S. is as follows: 1980, $260; 1981, $290/$260; 1982, $240; 1983, $280; 1984, $310; 1985, $240; 1986, $320*; mid-1987, $350* (asterisks indicate discounting off list prices).

SUPPLY/DEMAND (000 tons)



FORECAST (000 tons)

	1984	1985	1986e
Production[1]			
Semichemical	5,088	5,373	5,550
Recycled	1,359	1,551	1,630
Total	**6,447**	**6,924**	**7,180**
Capacity[1]			
Semichemical	5,411	5,528	5,557
Recycled	1,523	1,541	1,658
Utilization rates (%)			
Semichemical	94.0	97.2	99.9
Recycled	89.2	100.6	98.3
Imports[2]	65	99	115
Exports[1]	189	212	220
Apparent U.S. consumption			
000 tons	6,323	6,811	7,705
lb/capita	53.4	56.4	58.0
GNP ratio	1.76	1.85	1.88

1. American Paper Institute data.
2. Dept. of Commerce data.

TOP U.S. PRODUCERS (000 tpy)

	Annual capacity			Market share
	Semi-chem	Recycled medium	Total	(%)
1. Stone	651	169	821	11.4
2. O-I	670	—	670	9.3
3. Weyco	630	—	630	8.7
4. Inland	190	250	440	6.1
5. Smurfit[1]	90	285	375	5.2
6. Mead	345	—	345	4.8
7. IP	340	—	340	4.7
8. Va. Fibre	260	—	260	3.6
9. PCA	260	—	260	3.6
10. Willamette[2]	130	120	250	3.5

Market share of top five companies: **40.7%**
Market share of top ten companies: **60.9%**
Total U.S. capacity (1986):
7.215 million short tons

1. Includes 58% interest in Container Corp. of America (115,000 tpy semichemical, 165,000 tpy recycled) and 33% of Groveton Paper Board (100,000 tpy semichemical).
2. Reflects conversion of semichemical machine at Albany, Ore. (90,000 tpy) to linerboard in mid-1987.

SALES & EARNINGS

U.S. paper industry profits nearly double

The U.S. paper industry started 1987 off with a bang: first-quarter earnings rose 91.2% on increased sales of 23.3% compared with first-quarter earnings in 1986. Producers of market pulp, linerboard, and newsprint—commodity products which are in a favorable worldwide demand/supply balance—are cleaning up because of the weak dollar. Things are not going as well for nonintegrated mills and coated paper producers.

International Paper Co. more than tripled its earnings, although the quarter included a $14-million pretax gain from the sale of IP's stock holdings in Southwest Forest Industries Inc. John A. Georges, chairman and CEO, commented, "Our containerboard and pulp markets continue to do well, and lumber prices improved during the first quarter. Uncoated free-sheet markets have experienced competitive price pressures due to industry capacity increases, and, as expected, the coated papers business continues to be weak due to overcapacity and a continuing influx of imports."

James River Corp., which just ended its third quarter with earnings 144% above year-earlier levels, said that price improvements in communications papers and market pulp and "favorable results from all acquired Crown Zellerbach Corp. operations" more than offset competition in its folding carton and specialty papers segments.

Champion International Corp. attributed its 152% earnings improvement to "generally better market conditions, a sharp increase in wood products earnings, and continuing improvements in productivity." The company noted that a Jan. 1 price increase on uncoated paper was nixed when capacity from three new machines entered the market. Income from its paper group during the first quarter was approximately $9 million below fourth-quarter 1986.

Pulp, lumber producers prosper. Weyerhaeuser Co.'s earnings rose 104% from first-quarter 1985. George H. Weyerhaeuser, president and CEO, attributed the showing to "strengthening markets aided by the weakened dollar and improved manufacturing efficiencies, with most facilities operating at or near capacity." Weyco said it will "continue expansion through internal growth and acquisition," expecting good conditions into 1988.

Earnings at Georgia-Pacific Corp. increased 167% in the first quarter. Chairman and CEO T. Marshall Hahn Jr. noted, "Our pulp and paper division posted all-time operating profits of $82 million in the quarter, driven in part by continued favorable currency exchange rates."

Louisiana-Pacific Corp. had the highest quarterly sales in its history, while earnings rose considerably. L-P said its building products plants and its pulp mills operated near capacity. The company's Waferwood Div. had record sales during the quarter. In the second quarter of 1987, L-P will begin operating two new Waferwood plants in New Waverly, Texas, and Dawson Creek, B.C., bringing the company's annual production capacity to 2 billion bd ft/year.

U.S. paper/forest products industry first-quarter sales and earnings results.

	First quarter ($000)			
Companies	**Sales**	**Change 1987/86**	**Earnings[1]**	**Change 1987/86**
Boise Cascade	$912,220	0.36%	$40,150	60.6%
Bowater Inc.	282,931	41.4	11,813[2]	64.7
Champion Intl.	1,097,223	−2.24	55,468	152.1
Chesapeake Corp.	155,460	16.3	4,232	269.8
Consolidated	174,935	8.2	21,983	−6.2
Federal Paper	229,804	10.6	10,934	353.1
Fort Howard	394,303	23.4	35,107	−5.1
Georgia-Pacific	1,855,000	15.6	80,000[2]	166.6
P. H. Glatfelter	73,493	4.5	12,247	19.0
GN Nekoosa	566,700	16.2	43,300	211.5
International Paper	1,800,000	63.6	90,000[2]	260.0
James River (1/25)	1,057,588	73.8	41,691[2]	144.1
Jefferson Smurfit	255,838	13.6	14,861	279.3
Kimberly-Clark	1,183,200	14.1	75,100	2.6
Longview (1/31)	132,885	30.9	14,065	1,077.0
Louisiana-Pacific	422,900	31.1	16,310	1,099.3
Mead Corp.	957,000	40.3	34,200	68.5
Mosinee Paper	50,645	5.5	945	−61.6
Pentair Inc.	197,797	45.6	3,659	0.44
Pope & Talbot	100,303	35.4	6,651	1,338.0
Potlatch Corp.	248,628	6.6	17,786	30.4
Scott Paper	957,400	19.5	49,000	25.3
Sonoco Products	248,154	9.8	15,289	31.7
Southwest Forest	170,400	19.6	6,700	255.8
Stone Container	585,804	51.2	26,145	653.9
Temple-Inland	390,600	33.4	33,700[2]	147.8
Union Camp	537,018	8.5	44,197	100.5
Wausau (2/28)	60,404	8.3	2,764	8.8
Westvaco (1/31)	440,860	5.9	19,495	−3.8
Weyerhaeuser	1,617,343	23.8	101,917	103.9
Willamette	322,980	18.7	22,947	203.3
Total	**$17,479,821**	**23.3 %**	**$962,456**	**91.2%**

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years.
2. **Bowater:** 1986 quarter includes $6.3-million loss on retirement of assets. **Georgia-Pacific:** 1987 earnings include $6-million pretax gain from stock redemption. **International Paper:** 1987 earnings include pretax gain of $14 million from sales of securities. 1987 figures include **Hammermill Paper Co. James River:** 1987 earnings include $5.2-million gain related to sale of Gaylord Container. **Temple-Inland:** 1986 quarter includes $4.3-million gain on property and equipment.

one among others considered in the same province. Rumors indicate that another company there may add a newsprint machine. Crown Forest Industries Inc. has meanwhile slated a new thermomechanical pulp line for startup by mid-1988, adding 50,000 tpy of capacity.

Aside from tentative and firm projects involving newsprint expansions, various rumors have been circulating about other plans. One report is that another company aside from Ponderay is studying the feasibility of building a newsprint mill in Washington state. On the East Coast, various companies reportedly have investigated sites for a newsprint mill near Arkadelphia, Ark.

According to an Arkadelphia official, several groups have sought information over the past several years about the area's ability to support a paper mill. Since 1978, the city has worked with J.E. Sirrine Co. The engineering firm would not release the name of its client. Bowater Corp. and Kimberly-Clark Corp. were suggested by various sources as likely candidates, but each denied any involvement. International Paper Co. and Weyerhaeuser Co. also own land in the area, it was noted.

The rumor on the Washington state project separate from the Ponderay mill proposal has been just as difficult to confirm. Local sources say the unidentified company is considering sites for a $200-million newsprint mill in Pend Oreille and Grant counties, but has also considered sites in Montana, Alberta, and British Columbia. The consulting firm for the project, International Marketing and Technology Inc., Federal Way, Wash., refused to identify its client.

Market observers are concerned about too much new capacity coming onstream in the late 1980s and early 1990s if too many of the proposed projects are approved. The likely result is another downcycle of excess capacity, competitive markets, and low industry profits. Said one skeptic of the industry's traditional way of bringing on new machines, "they're like elephants; they come in herds." ■

North American newsprint projects, announced and proposed, 1987-1990

Announced company/mill	Capacity (metric tpy)	Startup	Project
Abitibi-Price	−60,000	1988	Convert No. 10 PM to directory paper
Alma, Que.			
BCFP	n.c.	1988	No. 2 PM rebuild
Crofton, B.C.	n.c.	1989	No. 1 PM rebuild
CIP	60,000	1987	New No. 4 PM replacing old one
Gatineau, Que.			
Crown Forest	50,000	1988	New TMP line
Elk Falls, B.C.			
Donohue	140,000	1987	New PM
Clermont, Que.			
Gaspesia	22,000	1990	Rebuild 2 PMs
Chandler, Que.			
Great Lakes	14,000	1987	No. 4 PM upgrade
Thunder Bay, Ont.	n.c.	1987	No. 3 PM upgrade
	60,000	1991	New PM
Kruger	90,000	1987	No. 2 PM rebuild
Corner Brook, Nfld.	162,000	1988	No. 7 PM rebuild
MacMillan Bloedel	35,000[1]	1987	Conversion of No. 9 PM, pulp expansion
Powell River, B.C.			
Newsprint South	205,000	1989	Proposed new mill
Grenada, Miss.			
Ontario Paper	n.c.	1987	Expansion of deinking pulp mill
Thorold, Ont.			
Smurfit Newsprint			
Newberg, Ore.	n.a.	n.a.	New recycled fiber plant
Oregon City, Ore.	n.a.	n.a.	Nos. 1, 3, 4 upgrade
Soucy	n.c.[2]	1988	No. 2 PM rebuild
Riviere-du-Loup, Que.			
Proposed company/mill			
Bear Island	200,000	n.a.	Proposed new PM
Ashland, Va.			
CIP	225,000	n.a.	New mill
Gold River, B.C.			
Donohue Normick	210,000	n.a.	New PM
Amos, Que.			
GLFP/Ponderay	154,000	n.a.	Proposed new mill
Usk, Wash.			
Finlay Forest	n.a.	n.a.	Proposed new PM next to pulp mill
MacKenzie, B.C.			
Southeast	146,000	n.a.	Proposed second PM, recycled newsprint
Dubiln, Ga.			
Undetermined	159,000	n.a.	Proposed new mill, recycled newsprint
Richmond, Calif.			

1. Includes newsprint and groundwood papers.
2. Groundwood paper capacity to be raised 20,000 tpy.
n.c. = No change; n.a. = Not available.

FREE-SHEET

G-P approves second machine at Port Hudson

Georgia-Pacific Corp.'s board of directors approved the installation of a new 824-tpd uncoated free-sheet machine at the company's Port Hudson mill in Zachary, La. The machine will cost about $185 million and is slated for completion in the fourth quarter of 1988.

The first machine at the mill, which produces 660 tpd of cut-size, forms, and other offset grades, started up in April 1986 (*P&P*, July 1986, p. 29).

The new machine appears to be the largest printing and writing paper grade machine installed in North America. The first machine, a 378-in.-wide Valmet Sym-Former, was the largest such machine at the time of its installation. But G-P's record was taken away after the conversion of Champion International Corp.'s 380-in. No. 5 machine at Pensacola, Fla., to uncoated free-sheet late last year.

In addition, the company has begun engineering studies to expand the mill's market pulp production, presently 820 tpd, to coincide with the startup of the new machine. In-

Chemicals play increasing role in growth of mechanical pulping

Higher yields, attractive capital and production costs, opportunities in new markets, and other factors are pushing mechanical pulping to the forefront of activity in North America's pulp expansion arena. Chemicals are playing an important role in this recent growth by providing vehicles to make mechanical pulps stronger, brighter, and applicable to new end-use technologies. Consumption of pulping and bleaching additives is expected to jump again this year, while price and supply will move according to product type and source.

There have been fewer project announcements during the past 12 months than during the same period last year, but many of the announced projects came online. In Canada, the most significant startup was in Temiscaming, Que., where a PREX impregnator and a peroxide bleachery are now helping to produce bleached chemimechanical pulp (BCMP) for the market. This pulp will be used for tissue products and printing and writing grades. Three other operating lines (Domtar Inc., Consolidated-Bathurst and Ontario Paper Co.) have achieved successful results with a combination of well-engineered equipment and innovative chemical addition. The chemithermomechanical (CTMP) line in Durango, Mexico is now manufacturing saleable market pulp using pressurized impregnation and peroxide bleaching.

In the past eighteen months, expansion and greenfield mill project announcements have been numerous. New companies that have plans include Fiberco, Makin Pulp & Paper Ltd., Millar Western (all in Canada) and Evco. Existing sites converting to mechanical processes incorporating chemicals in the U.S. include: International Paper Co., Pine Bluff Ark., and Bear Island Paper Co., Ashland Va. And in Canada they include: MacMillan Bloedel Ltd., Powell River, B.C.; and Cascade Inc., Port Cartier, Que. CIP Inc. is installing peroxide bleaching in Trois-Rivieres, Que., for its newsprint products.

Consumption. With all of these projects moving foward, chemicals for pulping and bleaching are being consumed in parallel with the production curve. The chemical garnering most of the success is hydrogen peroxide. With a growing list of reliable suppliers, stability in price and storage, easy installation and application, and a proven background, peroxide has been a steady performer for companies desiring brighter mechanical pulp. At this writing, DuPont's Maitland, Ont., facility was delivering product and Degussa's Mobile, Ala., plant was just starting up. Oxychem Canada, a joint venture of L'Air Liquide and Atochem, is constructing a plant in Becancour, Que., scheduled for startup later this year. Interox and FMC also continue to be strong in the marketplace.

Predictions for consumption of peroxide overall have been closely realized, but the annual rate is on a "roller coaster." Incremental increases were characteristic of the early 1980s, but a boom is likely in the latter half of the decade. Sources conclude that the market for peroxide in North American mechanical pulping operations is currently about 25,000 short tons (100% basis), and should grow at least 5% to 7% through 1990.

The most widely used chemical for mechanical pulp bleaching is sodium hydrosulfite. Consumption of products delivered or generated is more than two times as great as hydrogen peroxide. The three major suppliers of this chemical are Olin, Virginia Chemicals, and Ventron. Each has chosen a different marketing path. Virginia Chemicals offers its V-Brite blend (see article on page 129), and has recently began sales of a 33% suspension of sodium hydrosulfite called Sus-Pen. Prior technology allowed only solutions of 11% and 13%. Ventron is still marketing its on-site generators and Borol solution, while Olin sells commodity product.

Bleaching chemical charges have not changed significantly, although they are influenced by the increasing amounts of sodium sulfite, caustic, and sodium bisulfite used in the pulping process. Bleaching additions are still typically 1% to 2% based on wood, while impregnating chemicals are higher than 2%, (particularly higher if the product is sold as market pulp for consumer tissue or printing and writing grades).

Price. The major chemicals seem to be headed in two directions. Sodium hydrosulfite is getting closer to list, with a firmer market showing strong demand and adequate supply. The list validity of Hydrogen peroxide remains unclear, but no one is apparently anticipating an upward movement in price for any of the shipped concentrations. As new plants come on stream and attain full production, a new list may be established.

—*Michael Ducey*

TABLE 1: **Chemicals used in mechanical pulping operations in North America.**

	1988 Consumption	% Increase	Price[3]
Sodium hydrosulfite[1]	70,000	4.5	0.64
Hydrogen peroxide[2]	25,000	7.0	0.32
Sodium sulfite	40,000	8.0	0.23

1. Courtesy of Virginia Chemicals.
2. Courtesy of E.I. DuPont.
3. List price, USD per lb., *Chemical Marketing Reporter.*

PULP BLEACHING CONCERNS FOCUS ON ClO_2 GENERATION, EFFLUENT CONTROL

P&P's fourth annual survey of bleach plant equipment shows increased interest in chlorine dioxide systems and new technologies

By MICHAEL J. DUCEY, Technical Editor

The recent strength in market pulp and white paper markets has prompted some paper companies to make more long-term commitments to chemical pulp bleaching lines, according to *Pulp & Paper*'s recent survey of mills and suppliers. The survey, currently in its fifth year, also disclosed a growing need for source security as well as a genuine concern for bleach plant effluent reduction.

This article, based on that survey, takes a comprehensive look at the current mill chemical consumption patterns, new supplier products and their markets, the latest developments from a number of North American research institutions, and provides some brief facts on worldwide chemical pulp production and growth over the past 12 months.

With input from some 150 respondents representing a variety of companies, the report covers most aspects of bleaching in the pulp and paper industry. Beginning in 1982 as a mailed questionaire, the study has since developed into a "forum" where suppliers, mills, and researchers can discuss the most current trends and developments for the benefit of all concerned parties. *Pulp & Paper* wishes to thank those individuals who participated in the survey.

As in the past, each participant is provided with a complete annual report on trends in chemical consumption (only summarized in this article). Extra copies of the 1987 report are available on request by writing to: *Pulp & Paper* Bleaching Survey, 500 Howard St., San Francisco, Calif. 94105.

API's production figures should reveal that chemical consumption will be much the same as it was in 1986. Our studies have shown that consumption decreases per bleach line are generally offset by either increased production of an existing line or the installation of a new line. An example of this is the documented decrease of hypochlorite use in mills across North America. Hypo has been cut by as much as 15%, yet the amount of chlorine and caustic may have incrementally moved upward in those areas.

Similarly, chemical mixer installations have been sold on the basis of reducing ClO_2 use. Although quite the opposite has actually happened, particularly in areas where fiber is difficult to bleach, this has allowed more throughput at equal or better quality and uniformity.

The greatest changes in chemical consumption have occurred in addition and substitution. Our study found significant percentage increases in the number of lines employing select chemical addition. In the U.S., oxygen used in the first caustic extraction stage jumped from 7% of all lines in 1983 to 35% in 1987. Chlorination stage ClO_2 rose about 20% in the same period, while hydrogen peroxide enjoyed a growth rate of about 30%. In Canada, nearly 90% of all lines use ClO_2 in the C-stage, 80% use oxidative extraction, and 40% use peroxide.

Further analysis of the survey figures shows even more interesting trends. For example, the actual amount of ClO_2 substitution in the chlorine stage also seems to be increasing. In the U.S. and Canada, twice as many lines are adding more than 10 lb/ton as did in 1983. Softwood chemical pulp production is lending itself to oxidative extraction, and the percent of lines reported above would need to be multiplied by 1.5 if this species were taken into consideration. Our figures for hydrogen peroxide use seem to be somewhat high, perhaps because they include those users who add it on occasion

Champion's Pensacola, Fla., mill uses a new three-stage bleaching technique, which offers a variety of advantages.

for export market pulp, special paper grades, and other more selective uses. A more accurate figure for lines dedicated to using hydrogen peroxide would be 25% (total North America). Although it is not reported independently, sulfur dioxide (usually no more than 1 lb/ton) continues to be used as an antichlor enroute to high-density storage.

CAPITAL EXPENDITURES. According to *Pulp & Paper's Project Report*, chemical pulp mill investments reached $298 million last year. The major projects represented in this figure include Champion International Corp.'s Pensacola, Fla., mill, where new oxygen delignification and short sequence bleach plant equipment were installed, and James River Corp.'s Naheola, Ala., mill, where two lines were split into three. Several boiler projects also contributed to the total.

In 1987, capital expenditures are running considerably lower than they were during the previous year. Less than $100 million reportedly will be spent, but that number may double, as orders for equipment to be installed next year are strong. Big ticket items such as dynamic mixers, innovative washers, and supervisory control systems have slowed somewhat since their rapid acceptance in the early 1980s.

FIGURE 1: **Oxygen delignification capacity worldwide.**

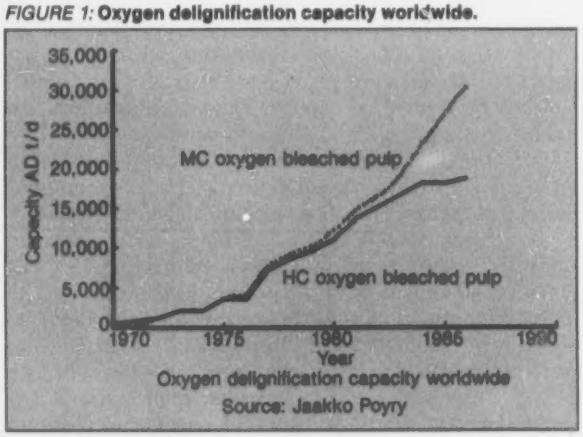
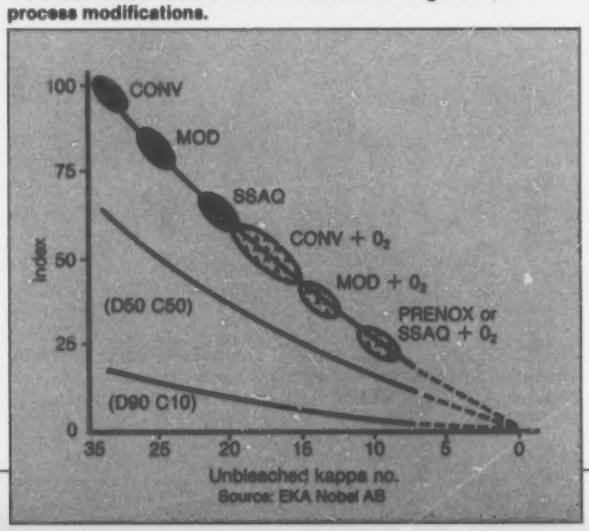


FIGURE 2: **Bleach effluent TOCl reduction through various process modifications.**



The larger projects are coming from some of the smaller mills. Two Wisconsin sulfite mills, Great Northern Nekoosa's Nekoosa Papers Inc. and Pentair Inc.'s Flambeau Paper Corp in Park Falls (see article on page 102 of this issue), are making changes in their sequences to incorporate oxygen technology (EO stage) while cutting hypochlorite to chlorine dioxide. Large mills seem to be directing more attention to chlorine dioxide generation, brownstock washing, and stage control that will help reduce chemical consumption in already overloaded bleach lines.

Several new lines are on the drawing boards at North American mills. Although construction announcements have not been forthcoming and technology selection has not been disclosed in all cases, it appears that oxygen delignification and short sequence bleaching are the major choices.

Mill locations mentioned for such upgrades include Lewiston, Idaho, Luke, Md., Eastover, S.C., Eureka, Calif., and Windsor, Ont. Major conversions are planned for Port Hudson, La., Moss Point, Ms., and many locations in the Midwest and Pacific Northwest.

ROAD TO BLEACHING. Considerable activity is being focused on the process area ahead of the bleach plant. Solutions to overworked brownstock washers are being sought, and new technology exploring alternatives to chlorination has come of age internationally. Bleach lines have been the benefactor of new technologies in mixing and controls, but in order to squeeze more pulp through without increased steam, effluent, and chemicals, those vital process steps leading to the bleachery must be closely examined.

In the brownstock washing area, the development and implementation of the horizontal washer has benefited more than 25 mills worldwide. An interesting side note has surfaced on this equipment recently. The two chief suppliers, Black Clawson and Sunds Defibrator, have agreed to offer an exchange of technology for potential buyers. The Black Clawson Chemi-Washer will now be designed to use the perforated steel band used in Sunds' Ultrawasher. The steel band lasts many times longer than the woven fabric (2 to 3 years vs 4 to 12 months), but costs of the unit are nearly $1 million (also meaning that spare parts are expensive).

Mills using these devices report that defoamer addition has been drastically reduced or eliminated, washing efficiency has improved with less chemical and lignin carryover, and more uniform pulp is received for bleaching. The units have also proved themselves in all areas of pulp manufacturing—sulfite, semichemical, kraft (with many in hardwood), and sawdust. Currently, 18 Chemi-Washers (11 in North America) and five Ultrawashers (with several on order) are in operation.

Information on the technology has been published by a number of sources, and operating data is available from the original designers based on experience gained at Georgia-Pacific Corp. (Crossett, Ark., and Bellingham, Wash.) and also from James River (Naheola). For more information on washing, please see the article on page 136 of this issue.

The compaction baffle filter from IMPCO is also gaining wider acceptance. Several orders have been received already this year. The equipment is being used in creative ways in both brownstock and bleach plant washing applications. It should be noted that IMPCO and Sunds Defibrator will soon be announcing new roles in supplying equipment and services to the pulp and paper industry. An agreement between United Paper Mills Ltd. (Finland), Svenska Cellulosa AB (Sweden), and Ingersoll-Rand occurred earlier this year, resulting in a joint venture formed from the equipment and technology supplier arms of each company (Jylhavaara, Sunds Defibrator, and IMPCO, respectively). No public information is available, but it is conceivable that each will have particular process areas in which to concentrate marketing and technology efforts.

Oxygen delignification has also been a hot topic lately, particularly in Europe, where environmental concerns associated with chlorine bleaching have caused debate. An issue closer to home, last year's drought in the southeast, has fueled interest in the process. Two oxygen delignification systems in the U.S. have recently started up, one at Champion in Pensacola and the other at Consolidated Papers Corp. in Wisconsin. Our survey showed that at least three other mills (all on the high end in chemical consumption) are interested in doing the same thing and have plans underway.

Internationally, it appears as if all Swedish mills will have oxygen delignification units in place by 1990, while Japan is a very close second. Brazil's Suzano mill recently announced its intention to construct the largest oxygen delignification line in the world (up to 1,350 tpd). Figure 1 shows the growth of systems worldwide.

Extended delignification in continuous digesters is also seen as an aid to bleaching. Three mills now use the technology, which involves a more even alkali profile combined with partial countercurrent operation, resulting in a 15% viscosity gain and an exit kappa number of 20 to 25. Another technology for prebleaching now being developed on a pilot scale (4 tpd) is the Prenox system, currently running at SCA/Nordliner AB's Ostrand pulp mill in Sweden. The pulp is treated with 1.5% NO_2 for an hour at 60° C and atmospheric pressure in preparation for an oxygen stage. A kappa number of 6 to 10 can be achieved, making bleaching a simple one- or two-step process. The system is environmentally sound.

The Weyerhaeuser Technology Center is maintaining its ozone pilot facility, but no further developments were reported. However, it was disclosed that a joint development project is being finalized. No details were given. Figure 2 shows alternate methods to chlorine-intensive bleaching and their benefits in kappa reduction.

TABLE 1: **Summary of participants.**

U.S.	
Mills reporting: 76	
Total bleaching lines: 95	
Tonnage represented: 17.8 million short tpy	
Percent of capacity: 79%	
Canada	
Mills reporting: 38	
Total number of lines: 44	
Tonnage represented: 6.8 million short tpy	
Percent of capacity: 64%	
Geographical breakdown	**Number of lines**
U.S. East	16
U.S. West	26
U.S. Midwest	12
U.S. South	39
Canada East	13
Canada Midwest	8
Canada West	23
	Number of people
Suppliers	43
Researchers	12

CHEMICAL GENERATION. The average age of ClO_2 plants across North America is close to 20 years. Since this is generally the designed lifetime for these facilities, ClO_2 plant overhauls should be a major area of interest through the 1980s. A few mills have already elected to install new or converted systems, including Brunswick Pulp & Paper Co., Bowater Inc., Mead at Kingsport, Tenn., G-P at Palatka, Fla., Domtar Inc. at Windsor, Que., James River at Camas, Wash., British Columbia Forest Products Ltd. at Crofton, B.C., and Western Pulp Ltd. Partnership at Squamish, B.C. Many others have begun trials to test the latest technology (see report on ClO_2 systems on page 61 of this issue).

Suppliers report that, generally, the main interest has been in expanding chlorine dioxide capacity, balancing saltcake, and reducing chlorine and water requirements. The R8 process from Erco has been very popular. This process increases ClO_2 output 50% to 100% from an existing R3 or SVP plant, while eliminating by-product chlorine and reducing saltcake by 40%. Three startups are known to be scheduled for 1987 and two for 1988.

Another popular system is the "L-Process" from Multifibre, which reportedly eliminates as much water as possible from the ClO_2 generating process, recycles acid/water/chlorate back to the generator, produces a sodium acid salt for black liquor recovery, and provides an efficient, safe, and easy-to-operate process at a low chemical, energy, and capital cost.

Onsite chloro-alkali systems have not been sold recently. Systems from Kemanord, MoDo Chemetics, the

HO group, and others are not being installed due to the availability and price of chlorine and caustic.

In recent years, great strides have been made in ozone generation technology. Economical and operational advances in producing this elusive chemical have stirred new interest in ozone bleaching. The more progressive projects are in Japan and Sweden, but several U.S. companies (on the supplier and paper industry sides) have efforts underway that may lead to a capital project soon. Many of the ozone-handling hurdles (particularly its concentration levels, pressure and temperature constraints in reduction, delivery, and application) are close to being overcome.

CONTROL TECHNOLOGY. Dual sensor control for bleaching stages is now being widely used. Although chlorination stage applications are fully saturated, a strong replacement market for this equipment still exists. A real potential for new products appears to be in controlling the latter stages of chlorine dioxide, hypochlorite, and sulfur dioxide (high-density storage).

A new set of sensors from Kajaani offers flow and consistency functions. Last year many mills were reportedly very interested in these new features, as the demand for tighter control of fiber properties and fiber itself continued to increase. The new Kajaani products do not require power in the field (power can be drawn from the equipment room), making installed costs lower and maintenance easier. The devices are designed to operate in a harsh environment and also under "duress," e.g. if one of the functions is lost, the other functions will continue to perform.

Supervisory system sales have been very slow during the past 12 months. This is due partly to saturation without much replacement and partly to the large capital outlays involved. Some sources feel that business may pick up soon for larger systems. Mills apparently have more capital funds available now than in the recent past, and the need to upgrade control capabilities certainly exists. Generally, many mills are controlling bleach stages on a single basis with no overall control scheme developed. One supplier mentioned that such mills seem eager to parlay these "patchwork" situations into fully automated distributed control systems.

CURRENT RESEARCH. In addition to the work on NO_2 and ozone bleaching, considerable fundamental research and some developmental research is focusing on the bleaching of chemical pulp. At the Institute of Paper Chemistry, research on the reaction kinetics of chlorination by PhD candidates is now underway. This work will examine low consistency (in a flow reactor) and high consistency (keying on fluidization) applications in hopes of devising a mathematical model.

At PAPRICAN, the Papricycle process for caustic extraction continues to develop. A way has been found to use this normally discarded alkali source to displace about one-third of the NaOH requirements in the first extraction stage. This procedure recycles the E1-filtrate to rewash the chlorinated pulp, following its normal wash, before it enters the E1 stage. Besides decreasing NaOH consumption, the process is also expected to reduce steam requirements in the extraction stage, since heat from the recycled effluent raises the temperature of the colder chlorinated pulp. Another series of projects is concentrating on modifications to oxygen delignification and oxygen extraction stages. This work will introduce chemical additives such as peroxide to make the stage more efficient in chemical consumption and to assist in brightening the pulp.

In the literature, information on ozone and oxygen combinations is ample and results vary. Sequences such as OZEP, OZED, etc. tested on hardwood species (primarily) can produce a pulp with good viscosity and 85 GE brightness, which is suitable for integrated mills. Research efforts on this concept are being closely guarded as commercial development approaches reality.

FUTURE OUTLOOK. Competing with oxygen delignification is the much-publicized use of high ClO_2 substitution in the chlorination stage. Some of the major oxygen delignification obstacles include recovery limitations, high investment costs, maintenance of pulp quality, lack of operational experience, and variable cost differences. Although employing a sequence primarily using ClO_2 cannot achieve the toxicity reduction of oxygen, it could be an incremental step in reducing chlorine consumption and therefore the effluent load exiting the bleach plant. Mills in North America using more than 10% ClO_2 substitution for chlorine include displacement bleacheries, mills in tight water situations, and those now operating short sequences.

Equipment-wise, bleach plants are becoming progressively more sophisticated. Although the market for mixers is somewhat saturated, growth of pumps, washers, and controls will be steady for many years. As a result, fresh steam and power requirements are expected to decrease. A main reason for this is the present and future acceptance of shorter bleaching sequences.

Technologies such as ozone bleaching, Prenox, biological pulping, etc. will need a commercial boost if any of these systems are to be integrated into bleach plant operations worldwide. There will be many more oxygen delignification units in the U.S., Canada, Finland, and wherever environmental concerns may "snowball" as they recently have in Sweden.

P&P's next bleaching survey this summer will ask a variety of mill bleach plant superintendents what alternative would be chosen if discharge levels of certain biologically sensitive material are cut in half. The results will be added to the data on chemical consumption and a forecast of bleaching in the twenty-first century will be presented as part of a report given at the International Pulp Bleaching Conference next year. ■